DETAILED DESCRIPTION OF OPERATIONAL PROCESSES FOR NORTHWEST MARINE AND ITS SUCCESSORS AT THE PORTLAND HARBOR SHIPYARD[1]

Introduction

The intended purpose of this report is to describe in detail the ship repair production processes performed by Respondent at the Property and at the Shipyard. All capitalized terms that are not defined in this report have the meanings given to them in the Information Request responses, to which this report is attached, with the exception of the term *Respondent*. With respect to this report only, the term *Respondent* shall mean, collectively, Northwest Marine, Inc. and its successors-in-interest, BAE Systems San Diego Ship Repair Inc. and Marine Group LLC.

The first part of the report is a basic introduction to ship repair processes.

The Shipyard docking facilities are described in the second portion of the report. Docking facilities are a very important aspect to any shipyard. In the case of the Shipyard, all docking facilities were controlled and operated by parties other than Respondent, including the Port of Portland, during Respondent's Active Operations Period.

The third portion of this report provides an introduction to the basic processes, shops and facilities found on the Property.

Proper surface preparation and coating is essential in the ship repair industry to preserve the life of the products. The fourth portion of the report describes the shipyard surface contaminants, standards, and a variety of surface preparation techniques, and also provides an overview of coating systems, paint application equipment, and painting processes throughout the Shipyard and the Property.

Finally, the fifth portion of the report deals with Respondent's waste management activities. This section discussions the generation, management and disposal of both nonhazardous and hazardous wastes. Additionally, asbestos and PCBs generated from ships are discussed.

[1] This report is dated November 5, 2008, and is attached to and incorporated into: 1) the Portland Harbor Superfund Site Information Request Responses from BAE Systems San Diego Ship Repair Inc.; and 2) the PORTLAND HARBOR SUPERFUND SITE INFORMATION REQUEST RESPONSES FROM MARINE GROUP LLC AND NORTHWEST MARINE, INC.

Part 1

Introduction to Steel Shipbuilding and Repair

The ship repair industry is centuries old, and like most other industries, its techniques have changed considerably with time. Changes are the result of variables such as material types, vessel design, ship sizes, market needs, and manufacturing technology.

Customers of shipyards include small private owners, large companies, and the U.S. Government. Contracts for various shipyard work generally involve a project bidding process similar to that used for most major construction projects. A repair contract is put up for bid, and bidders submit proposals to perform the work.

Introduction to the Ship Repair Processes Conducted at the Shipyard and the Property during Respondent's Active Operations Period:

The ship owner would send out a Request for Proposal (RFP), and the Shipyard and/or other contractors would respond with a proposal for the repair work. Repair contracts involved, among other things, overhauling engines, resurfacing the hull and superstructure, installing new electronics, and other repair and maintenance items. Ship repair contracts lasted anywhere from one day to over a year, depending on the complexity of the job. Repair contracts were generally under severe time constraints, and prompt delivery was very important. Failure to deliver a repaired ship on time could result in the contractor paying damages to the ship owner. Repair activities tended to be cyclic; therefore the workforce experienced surges in workload, making shipyard personnel management difficult. Therefore, subcontractors were used for repair activities in the Shipyard to help even out the staffing.

Shipyard Facilities:

The Shipyard was like most U.S. shipyards in terms of its facilities and processes. A major difference however between the Shipyard and other U.S. shipyards was that all of the Shipyard's piers, wharfs, and dry-docks, and several of the production facilities, were owned and operated by the Port, either directly or through Cascade General (all references herein to the Port include Cascade General, during the period it operated the Shipyard). This was very unusual, as very few port districts actually owned and operated ship repair yards, although in some instances, the land on which a shipyard was located was leased from a port district. Therefore, it is important to keep in mind that, while Respondent also owned and operated certain facilities, and conducted certain ship repair processes on its land-locked Property, a large portion of the work described herein was performed at Shipyard facilities, docks, piers and wharfs owned and operated by the Port.

For the purpose of clarity, any operations or processes performed in facilities owned or operated by Respondent will be identified as "NWM." Any operations or processes performed in facilities owned or operated by the Port will be identified as "Shipyard."

Shops and Facilities Utilized:

- Dry-docking Facilities – Shipyard
- Shipbuilding Positions – Shipyard
- Piers and Berthing Positions – Shipyard

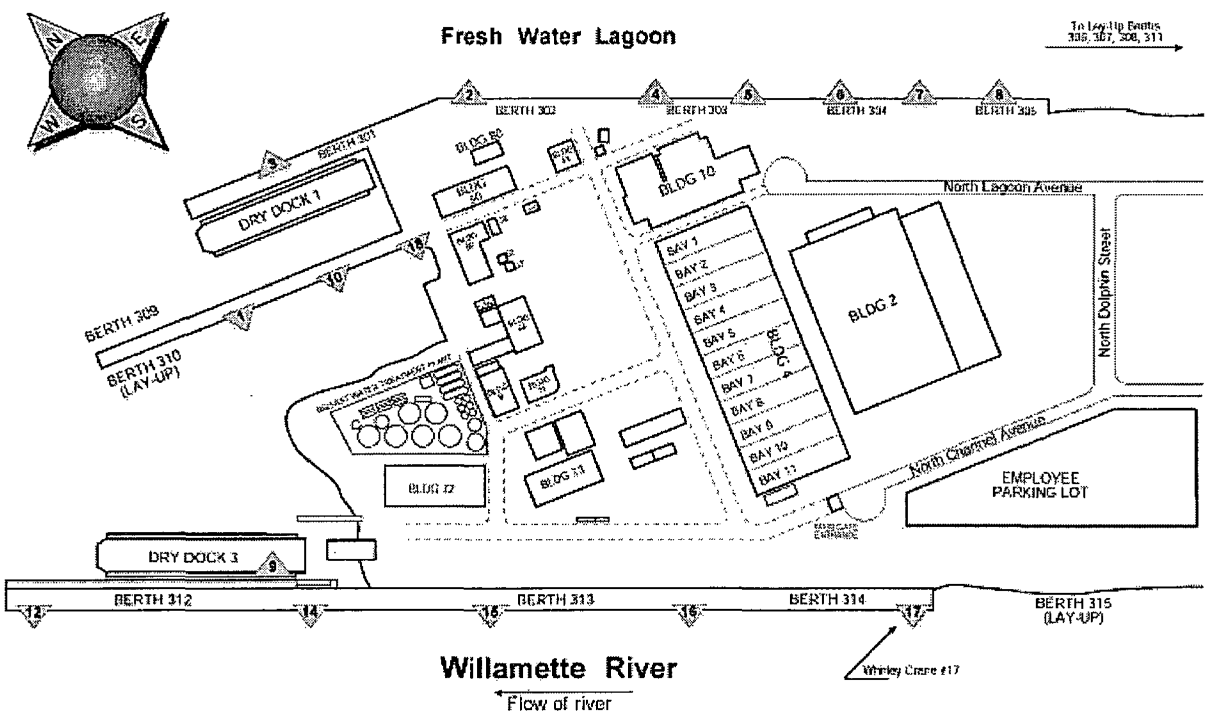
- Work Shops:
  - Sheet Metal Shop – NWM
  - Steel Assembly Shop – NWM
  - Pipe Shop – NWM
  - Machine Shop – NWM
  - Carpentry Shop – NWM
  - Maintenance Shop – NWM
  - Electrical Shop – NWM
  - Paint and Blast Shops – NWM and Shipyard
  - Plate Shop – NWM
- Work Areas – NWM and Shipyard
- Steel Storage Area – NWM
- On-Board Construction – Shipyard
- Other Office Buildings – NWM
- Materials Warehouses – Shipyard and NWM
- Engineering and Planning – Shipyard and NWM
- Administration, Medical, Safety and Environmental – Shipyard and NWM
- Security – Shipyard

Part 2

Shipyard Docking Facilities

Shipyards can be thought of as an integration of individual facilities and processes that are combined together to facilitate the production and/or repair of ships. Generally, the largest or most expensive facilities in the shipyard are its docking facilities. The ship repair industry relies heavily on docking facilities, and in many cases, a shipyards' industrial capabilities are evaluated on the quantity, size, and type of docking facilities it possesses. Ships can be either wet-docked or dry-docked. A wet-dock, or berth as it is commonly called, is a pier or a wet slip position next to which a ship can dock and tie up. A ship that has its entire hull exposed to the atmosphere is said to be dry-docked. The floating dry-dock is a floating vessel secured to land that has the ability to be lowered under the water's surface to raise ships above the water surface level. Floating dry-docks are generally used for ship repair, but in some cases they are also used for ship construction. Dry-docks range anywhere from 50 to 1000 feet in length. In 1963, the Port built Dry-Dock 3, then the largest floating dry-dock in the Americas. In 1979, Dry-Dock 4, the then largest floating dock in the Western Hemisphere, was operational.

Dry-Dock 4 was sold and transported to the Grand Bahamas Shipyard in 2002, where it was renamed No. 2 Dock. Dry-Docks 3 and 1 remain at the Shipyard, in the configuration shown below.



Dry-dock Ballast Compartments and Buoyancy Chambers: Most of the floating dry-dock structure is used as ballast tanks and buoyancy compartments for raising and lowering the dock. Most of the pontoon deck and side walls house buoyancy chambers and ballast tanks. The main difference between a ballast tank and a buoyancy chamber is that water never enters a buoyancy chamber. Water is pumped into the ballast tanks and causes the dock to submerge. The amount of water pumped into the ballast compartment determines the depth to which the dry-dock will submerge. When water is pumped out of the ballast tanks, the dry-dock returns to the water's surface. Buoyancy chambers are, as the name implies, sealed areas that maintain a certain amount of buoyancy to protect the dock from sinking too deep; they also aid in keeping the vessel level. Buoyancy chambers are located in both of the wing walls and under the pontoon deck. Since they are not subjected to flooding, many buoyancy chambers are used for machinery space, equipment storage, personnel quarters, mess rooms, workshops, and other activities. Proper functioning of the ballast compartments and the buoyancy chambers is instrumental in proper floating dry-dock operations. Some of the newer floating dry-docks have computer operated systems that control the raising and lowering of the docks.

Floating Dry-Dock Operation: The floating dry-dock consists of pumps and associated ballast tanks used to raise ships above the water level for work that requires exposure of the hull. When ballast tanks are flooded the dock begins to submerge. A ship is then strategically positioned over bilge and keel blocks located on the pontoon deck. The position is maintained while the ballast tanks are de-watered. The de-watering process raises the dock and thus the ship above the water surface level. Once the ship is dry-docked, it is generally hooked up to land-based utilities to keep its systems operational during docking.

The side wall, and thus the entire dock, is secured to land in one or more locations to prevent the dock from floating away. Wing walls have a railway, gears, or some type of mechanical system that allows the dock to be raised and lowered. Usually one attachment is located at the shore entrance of the dock and the other is located on the outside of one of the side walls.

Procedures for Docking and Undocking: The specific procedures will vary from shipyard to shipyard, but the general operations are as follows:

1. Dry-dock is cleaned and cleared of equipment to allow for immersion into underlying waters.
2. Keel and bilge blocks are positioned on the pontoon deck. The location, quantity, and size of keel and bilge blocks are dependent upon the size and shape of the ship being docked.
3. Once the keel blocks are in place and the dock is ready to submerge, water is pumped into the ballast tanks.
4. The ship is positioned correctly over the keel and bilge blocks. The ship is usually secured in position by bow and stern lines from the upper deck to the wing walls.
5. Air replaces water in the ballast tanks, causing the dock to become buoyant enough to float both the dock and the ship. The ship is now dry-docked.
6. The final step in the operation is to hook the ship up to land-based utilities.

Shipyard Wharfs and Piers: During a ship's stay at the Shipyard it was often docked at a pier or wharf. The Shipyard had a variety of berthing positions depending on the ship's size and configuration. Repairs of ships were also performed at berth. (See figure above for berthing positions at the Shipyard.)

Piers and wharfs provide a place for ships to wet-dock or berth and in many cases are constructed differently. Piers extend longitudinally into the nearby waters and are supported by columns that are driven down into the underlying soil. Piers are set up to berth ships on either side of the pier. The depth of the water surrounding the piers is dependent on the requirements for draft of docking ships. Frequent dredging may be required to maintain the desired depth of surrounding waters.

Utilities Supplied by the Shipyard's Docking Facilities: When a ship is docked for repairs many utilities need to be supplied to the ship, shipyard workers, and the ship's crew. The ship needs utilities to support production and repairs and supply shipboard systems. System support utilities include: fresh water, power, steam boilers, grey and black water discharges, and seawater for cooling and fire systems. Production support utilities include: electric power, compressed air, oxygen, and argon. Ships docked at the Shipyard were hooked up to land-based utilities, such as:

- Fresh Water
- Boilers for Steam
- Disposable Receptacles for Sanitary Wastes
- Disposable Receptacles for Solid Wastes
- Tanks and Pumps
- Compressed Air
- Electric Power
- Welding Gases
- Fire Systems
- Telephone
- Waste Water Removal

Part 3

<u>Basic Processes, Shops and Facilities at NWM</u>

Steel Ship Repair Practices and Processes: Ship repair by Respondent included ship conversions, overhauls, maintenance programs, major damage repairs, and minor equipment repairs. A typical ship repair contract required a timely coordination and an aggressive bidding process. Repair work customers included the U.S. Navy, commercial ship owners and other marine structure owners.

The customer would provide contract specifications, drawings, and standard items. Contracts were "firm fixed price," "firm fixed price award fee," "cost plus fixed fee," "cost plus award fee," or urgent repair. The process started in the marketing area when Respondent was provided a RFP or an Invitation for Bid (IFB). The lowest price usually won an IFB contract, while a RFP award could be based on factors other than price. The repair estimating group prepared the cost estimate and the proposal for the repair contract. Bid estimates generally included labor rates, materials, overhead, special service costs, subcontractor costs, overtime/shift premiums, other fees, cost of Shipyard facilities, and cost of money (interest), totaling the estimated price of the contract.

Common Types of Repair Work Conducted by Respondent: Ships are similar to other types of machinery in that they require frequent maintenance and, sometimes, complete overhauls to remain operational. Examples of maintenance and repair duties that Respondent conducted included:

- Blasting and repainting hull freeboard superstructure and interior tanks and work areas
- Major machinery rebuilding and installation (*e.g.*, diesel engines, turbines, generators, and pump stations)
- Systems overhauls, maintenance, and installation (*e.g.*, piping system flushing, testing, and installation)
- New system installation, either new equipment added to the ship or systems that were in need of replacement (*e.g.*, navigational systems, combat systems, communication systems, and updated piping systems)
- Propeller and rudder repairs, modification, and alignment
- Creation of new machinery spaces on the ship (*e.g.*, cut-out of existing steel structure and adding new walls, stiffeners, vertical, and webbing)

In many cases, repair contracts were on an emergency basis with very little warning. Repair ships typically stayed in the Shipyard from 3 days to 2 months, while major repairs and conversions often lasted over one year.

Large Repairs and Conversion Projects: Large repair contracts and major conversions are common in the ship repair industry. Examples of major repairs include:

- Conversion of supply ships to hospital ships
- Cutting a ship in half and installing a new section to lengthen the ship
- Replacing segments of a ship that has run aground
- Complete rip-out, structural reconfiguration and outfitting of combat systems

- Major remodeling of ship's interior or exterior (*e.g.*, complete overhauls of passenger cruise ships)

Most major repairs and conversions require a large planning, engineering, and production effort. In many cases, a large quantity of steel work will be needed (*e.g.*, major cut-out of existing ship structure and installation of new configurations). These projects can be divided into four general stages: 1) removal of old structure; 2) building new structure; 3) equipment installation; and 4) testing. Respondent used subcontractors for many major and minor repairs and conversions. The subcontractors provided expertise in specialized areas and helped to balance Respondent's labor force. Work that subcontractors performed for Respondent included:

- Support of ship repair
- Major combat systems installations (technical)
- Boiler retubing and rebuilding
- Air compressor overhauls
- Lagging removal and disposal
- Tank cleaning
- Blasting and painting
- Pump system overhauls
- Small structural fabrication
- Winch overhauls
- Main steam system modifications
- System fabrications (*e.g.*, piping, ventilation, and foundations)

All installed systems must be tested and operational before the ship is delivered back to its owner. Testing requirements generally originated from the contract, although other sources of testing requirements do exist (*see, e.g.*, NAVSEA standard items and reference memos at http://www.navsea.navy.mil/content/References/NAVSEA_Instructions.aspx). The tests must be scheduled, tracked for proper completion, and checked off by the proper groups (*e.g.*, shipyard internal quality, SUPSHIP (U.S. Navy Supervisors of Shipbuilding, Conversion & Repair), Ships Force, government agencies, and ship owners). Once systems are in place and properly tested, the areas, compartments, and/or systems are considered "sold to the ship" (*i.e.*, completed).

Support Shops for Ship Repair at NWM: Support shops are an important part of a shipyard's overall production process. In some cases, the support shops are small manufacturers producing goods to support the production effort. Other support shops mainly provide services to the shipyard that support production (*e.g.*, maintenance and carpentry shops).

<u>Pipe Shop</u>: The pipe shop was responsible for manufacturing and assembling piping systems. Small pipe sections known as "pipe spools" were assembled in the pipe shop and transported to the stages of construction (*i.e.*, assembly, on-block, on-unit, and on-board). Pipe spools are shaped and manufactured per engineering design, scheduled for construction, and sent to the various stages for installation. Many pipe shops would tag the spools to identify the location for installation on the ship. Some of the processes in the pipe shop included: pipe welding (arc, MIG, TIG, and pulse arc), pipe bending, flux removal, grit-blast, painting, and pressure testing.

Equipment used at the pipe shop included pipe welders, lathes, pipe cutting saws, shears, grinders, chippers, hole cutters, pipe benders, and transportation equipment.

A detailed Process Flow Chart for Pipe Fabrication and Pipe Fitting operations, as performed by Respondent, is provided in Appendix 1: NWM Process Flow Charts. Some of the Material Safety Data Sheets (MSDS) from the time Respondent was in operation are being submitted (see document type "Materials Safety Data Sheet" in the electronic document database submitted herewith), but most have not been located. It is believed that most MSDS were disposed of at or shortly after November 9, 1992, the date on which Respondent concluded active operations. However, most materials utilized by Respondent are similar in composition to those materials used for the same processes today. Therefore, current MSDS for common materials utilized for pipe shop processes are included in Appendix 2: Material Safety Data Sheets.

Material inputs to the processes included:

1) Fabrication Materials
    a) Metal Pipe
    b) Cleaning Solvents
    c) Petroleum Oils and Lubricants
2) Shop Disposables/Consumables
    a) Shop Rags
    b) Welding Gasses
    c) Welding Wire and Stick
3) Hydro testing
    a) Water
4) Transportation Equipment
    a) Forklifts
    b) Cranes
    c) Trucks

Process outputs included:

1) Fugitive Air Emissions
    a) Welding Fume
2) Fabrication Wastes
    a) Metal Fab Waste
    b) Metal Cuttings
    c) Waste Oil & Lubricants
3) Waste Disposables
    a) Shop Rags

b) Welding Sticks

4) Hydro test waste

a) Waste Water

5) Installation Waste

a) Various Waste Disposables

Machine Shop: Machining shops serve a shipyard's machining needs, though the exact functions of shipyard machine shops vary throughout the shipbuilding industry. Typical machine shop equipment consists of end mills, lathes, drill presses, CNC milling machines, band saws, large presses, work tables, cleaning tanks, and other machining equipment.

A detailed Process Flow Chart for Machine Shop operations, as performed by Respondent, is provided in Appendix 1: NWM Process Flow Charts. Some of the MSDS from the time Respondent was in operation are being submitted (see document type "Materials Safety Data Sheet" in the electronic document database submitted herewith), but most have not been located. It is believed that most MSDS were disposed of at or shortly after November 9, 1992, the date on which Respondent concluded active operations. However, most materials utilized by Respondent are similar in composition to those materials used for the same processes today. Therefore, current MSDS for common materials utilized for machine shop processes are included in Appendix 2: Material Safety Data Sheets.

Material inputs to the processes included:

1) Fabrication Materials

a) Steel and Other Metals

b) Cleaning Solvents

c) Petroleum Oils and Lubricants

2) Shop Disposables/Consumables

a) Shop Rags

b) Welding Gasses

c) Welding Wire and Stick

3) Transportation Equipment

a) Forklifts

b) Cranes

c) Trucks

Process outputs included:

1) Fugitive Air Emissions

a) Welding Fume

2) Fabrication Wastes

a) Metal Fab Waste

b) Metal Cuttings

c) Waste Oil & Lubricants

3) Waste Disposables

a) Shop Rags

b) Welding Sticks

4) Hydro test waste

a) Waste Water

5) Installation Waste

a) Various waste disposables

Sheet Metal Shop: The sheet metal shop was responsible for fabricating and installing ventilation ducting and vent spools. Using engineering drawings and special sheet metal tools, this shop produced ventilation systems for new construction as well as repair work. The shop cut, shaped, bent, welded, stamped, painted, and performed a variety of manufacturing operations for ship ventilation systems. Often sheet metal shops are responsible for assembling large ducting fans and heating and air conditioning components. Sheet metal workers perform the installation of the ducting in various stages of construction (*i.e.*, on-block, on-unit, and onboard).

A detailed Process Flow Chart for Sheet Metal Shop operations, as performed by Respondent, is provided in Appendix 1: NWM Process Flow Charts. Some of the MSDS from the time Respondent was in operation are being submitted (see document type "Materials Safety Data Sheet" in the electronic document database submitted herewith), but most have not been located. It is believed that most MSDS were disposed of at or shortly after November 9, 1992, the date on which Respondent concluded active operations. However, most materials utilized by Respondent are similar in composition to those materials used for the same processes today. Therefore, current MSDS for common materials utilized for sheet metal shop processes are included in Appendix 2: Material Safety Data Sheets.

Material inputs to the processes included:

1) Fabrication Materials

a) Sheet Metal

b) Cleaning Solvents

c) Petroleum Oils and Lubricants

2) Shop Disposables/Consumables

a) Shop Rags

b) Welding Gasses

c) Welding Wire and Stick

3) Transportation Equipment

a) Forklifts

b) Cranes

c) Trucks

Process outputs included:

1) Fabrication Wastes
    a) Metal Fab Waste
    b) Metal Cuttings
    c) Waste Oil & Lubricants
2) Waste Disposables
    a) Shop Rags
    b) Welding Sticks
3) Scrap Metal
    a) Various metal scraps
4) Fugitive Air Emissions
    a) Welding Fumes
5) Installation Waste
    a) Various Disposables

Electrical Shop: Electrical shops in a shipyard perform a variety of functions throughout the industry. In many cases, the electrical shop installs, rebuilds, builds, and tests electrical components (*e.g.*, motors, lights, transformers, and gages). The electrical shop electricians also install the electrical equipment on the ships. Electrical technicians inspected equipment, ordered new equipment and parts, trouble-shot equipment failure, identified mechanical and electronic problems and repaired systems and equipment. For ship repairs, the electricians worked only in the NWM electrical shop or onboard ships in the Shipyard. The most common task was to rebuild electrical motors on the ship. If possible the motors were removed from their station on the ship and rebuilt in the NWM electrical shop. If it was not possible to remove the motor, the electrician would work aboard the ship in the Shipyard. Electricians also performed maintenance on the NWM shop facilities.

A detailed Process Flow Chart for Electrical Shop operations, as performed by Respondent, is provided in Appendix 1: NWM Process Flow Charts. Some of the MSDS from the time Respondent was in operation are being submitted (see document type "Materials Safety Data Sheet" in the electronic document database submitted herewith), but most have not been located. It is believed that most MSDS were disposed of at or shortly after November 9, 1992, the date on which Respondent concluded active operations. However, most materials utilized by Respondent are similar in composition to those materials used for the same processes today. Therefore, current MSDS for common materials utilized for electrical shop processes are included in Appendix 2: Material Safety Data Sheets.

Material Inputs to the process include:

1) Fabrication Materials
   a) Electrical cable and wire
   b) Resin
   c) Oils and Lubricants
2) Shop Disposables/Consumables
   a) Shop Rags
   b) Cleaning solvents
   c) Cable spools
3) Transportation Equipment
   a) Forklifts
   b) Cranes
   c) Trucks

Process Outputs in the process include:

1) Fabrication Wastes
   a) Electrical Fab Waste
   b) Cable and Wire Cuttings
   c) Waste Oil & Lubricants
   d) Spent solvents
2) Waste Disposables
   a) Shop Rags
3) Scrap Metal
   a) Various metal scraps
4) Fugitive Air Emissions
   a) Dip solvent tank emissions
5) Installation Waste
   a) Various Disposables

Plate Shop: The plate shop is a generic term used for the area and process in a shipyard that provides steel parts cutting, bending, and sub-assembly. The plate shop uses information from engineering drawings to produce plate shapes. The shapes are cut and formed as needed. The plate shop has manual and computer-controlled machinery. The types of machinery commonly found in the plate shop are cutting machines, steel bending machines and plate bending rolls, shearing machines, presses, and hole punching equipment. The plate shop sends parts and subassemblies that it outputs to the ship for installation.

Respondent had a plate shop operation at the Property. However, if large or complex work was necessary for a repair effort, Respondent would have the plates fabricated off site and transported to the Shipyard for installation.

Support Services for Ship Repair Processes:

Support services are important to ship repair operations. Support services personnel perform functions ranging from general yard cleanup to utilities to rigging cranes, and support and facilitate production with their knowledge and labor. Support services needed in the shipyard include:

<u>Production Services</u>: The production services shops are sometimes grouped into one department. The services they provide are instrumental in the overall operation of the shipyard. Services provided by this department include: carpentry, scaffolding installation, facility and equipment maintenance, and other production support activities. As the name implies, these shops are designed to service production in the ship repair process.

<u>Materials Transportation and Warehousing</u>: Materials throughout the shipyard are generally controlled by a transportation and materials department. The materials (*e.g.*, pipes, lights, and venting) need to be delivered to the proper location in the shipyard to be installed. This department uses forklifts, trucks, cranes, carts, carriers, and other materials transport equipment. Materials received through the materials department are checked for quality, quantity, and proper invoicing before they are sent to the warehouse. The materials are then packaged in work packages and prepared for shipment to production at the various stages.

A detailed Process Flow Chart for Materials Transportation and Warehousing operations, as performed by Respondent, is provided in Appendix 1: NWM Process Flow Charts. Some of the MSDS from the time Respondent was in operation are being submitted (see document type "Materials Safety Data Sheet" in the electronic document database submitted herewith), but most have not been located. It is believed that most MSDS were disposed of at or shortly after November 9, 1992, the date on which Respondent concluded active operations. However, most materials utilized by Respondent are similar in composition to those materials used for the same processes today. Therefore, current MSDS for common materials utilized for materials transportation and warehousing processes are included in Appendix 2: Material Safety Data Sheets.

Material inputs to the processes included:

1) Packaging Materials
    a) Wood
    b) Foam/Paper
    c) Banding Wire/Shrink Wrap
2) Transportation Equipment
    a) Forklifts
    b) Cranes
    c) Trucks

Process outputs included:

1) Packaging Material Wastes
   a) Various Nonhazardous Solid Waste

Subcontractors in the Shipyard: Respondent frequently used subcontractors. They performed many of the functions the production workers and support shops in the Shipyard and NWM performed. Subcontractors performed painting, blasting, ventilation production and installation, piping system installation, electrical installation, and many other processes.

Major Production Facilities for Ship Repair:

Rolls: Rolls are large facilities that bend and shape steel plates. The rolls frequently consist of three large cylindrical steel shafts and a motor drive and are used to form the curved surface plates for the curved portion of the hull. Rolls vary greatly in size and technology from shipyard to shipyard. Some of the newer rolls are computer controlled, while the older machines are manually positioned and operated.

Pin Jigs: Pin jigs are platen lines used to assemble curved blocks, and are situated throughout the shipyard into process lanes. The pin jig is one of the simplest and most effective facilities developed by the modern shipbuilding industry. A pin jig is simply a series of vertical screw jacks that support curved blocks during construction. The jacks can be adjusted to the desired curvature. Curved blocks form the outside of the hull's curved surface; mechanizing the production of curved blocks is much more difficult than that of rectangular blocks. Curved blocks are three dimensional panels consisting of:

- Rolled plates
- Shaped sections
- Profiled plates
- Shell plates
- Shell longitudinales
- Webbed frames and stringers

The most common method to assemble these blocks is on a pin jig set up specifically for the curved block. The legs of the jig are telescopic and therefore easily adjustable for different curved blocks. The jig heights are usually determined from the engineering drawings and production information.

Materials Handling and Transportation Equipment: Materials handling and transportation is an important aspect of ship repair. Material handling and transportation equipment at the Shipyard and NWM can be subdivided into three major categories – cranes, industrial vehicles, and containers.

Cranes: Cranes are a common type of material handling equipment used in ship repair. In many cases, they are the only method for moving large materials around the shipyard. In repair operations, cranes are used primarily to load materials onto the ship. Crane types come in a variety of sizes and shapes, depending on the shipyard and its associated applications. The four main types of cranes used in shipyards are bridge cranes, jib cranes, gantry cranes, and mobile cranes. Bridge cranes require support much like a bridge. The bridge crane travels on two wall-type structures with rails on top. Small bridge cranes are used to move parts throughout shops for material movement, production, and assembly. Most large bridge cranes are used to move heavy steel plates from one work area of a platen to another and are used to assemble sub-assemblies and blocks. Most bridge cranes have electromagnets or clamps to attach steel plates being transported and/or assembled. There currently are a total of 17 Whirley cranes in the Shipyard with a tandem lift capacity of 220 long tons (223 metric tons).

Mobile cranes are used for smaller materials that are not located in a centralized area. The mobile cranes have rubber tires and can drive to nearly all locations in the Shipyard. As expected, the mobile cranes have lower limits with respect to the size, shape, weight, and height of material that can be transported.

Containers and Container Movers: Containers at the Shipyard consisted primarily of boxes, pallets, drums, and tanks. Containers are important for consolidation of like material to facilitate more productive materials movement. Containers are used to transport small units, packages of piping, steel foundations, paint, and trash. Movement of these containers is performed by forklifts, small cranes, transport flatbeds, mule trains, and special lift vehicles.

A detailed Process Flow Chart for Containers and Container Moving operations, as performed by Respondent, is provided in Appendix 1: NWM Process Flow Charts. Some of the MSDS from the time Respondent was in operation are being submitted (see document type "Materials Safety Data Sheet" in the electronic document database submitted herewith), but most have not been located. It is believed that most MSDS were disposed of at or shortly after November 9, 1992, the date on which Respondent concluded active operations. However, most materials utilized by Respondent are similar in composition to those materials used for the same processes today. Therefore, current MSDS for common materials utilized for containers and container moving processes are included in Appendix 2: Material Safety Data Sheets.

Material inputs to the processes included:

1) Fuels
   a) Gasoline
   b) Diesel Fuel
2) Oils and Lubricants
   a) Motor Oil
   b) Other Rolling Stock Lubricants

Process outputs included:

1) Operational Outputs
   a) Fuel leaks/spills
   b) Oil leaks/spills
   c) Fugitive engine emissions
   d) Waste engine oil and other petroleum

Part 4

Surface Preparation and Painting

Surface Preparation and Coating Operations: The marine environment has detrimental effects on nearly all ships and shipboard components. Corrosion and deterioration are a continual problem in open air and saltwater environments, as well as in tanks onboard ships that contain materials such as fuel oils, fuel, septic, and other corrosive substances. Maintaining the ship's structural integrity is the main purpose of the shipboard paint system. Therefore, proper surface preparation and coating system application are essential in the shipbuilding industry to preserve the life of the ship's products.

Introduction to Surface Preparation: The steel structure must be protected from the environment to maintain its structural integrity. Coating systems serve the purpose of corrosion protection, and surface preparation is the interface for coating system adhesion. To a large extent, the effectiveness of the surface coating relies on the quality of surface preparation. All paints will fail eventually, but the majority of premature failures of paint systems are due to loss of adhesion caused by improper surface preparation.

Some type of abrasion is necessary to remove surface contaminants prior to application of coating systems. Abrasion is usually accomplished mechanically, using air pressure, centrifugal action, abrasion (sanding), and/or direct contact (chipping and scraping). The choice of surface preparation methods involves the following considerations: surface contaminants, paint type, required surface profile, cost, safety, pollution, available equipment, and other production-related constraints.

Surface Contaminants: Surface preparation techniques are used to remove surface contaminants such as mill scale, rust, flash rust, dirt, salts, old paint, grease, and flux. Contaminants that remain on the surface are the primary causes of premature failure of coating systems. The following is a brief discussion of five common surface contaminants:

Mill Scale: Mill scale is a residue which forms on the surface of new steel that is hot rolled. As the steel cools, a residue of iron oxides forms a "tight skin" or "crust" called mill scale over the entire surface. Mill scale is bluish, shiny, and smooth. In many cases, mill scale is difficult to detect. The main problem with mill scale is that rust may form under the scale after a paint system has been applied.

Rust: When it is time to apply coating systems to the ship, the rust should be removed from the surface. Painting over rust will lead to uneven coating and will cause premature failure of the coating system. However, in some surface preparation techniques small quantities of rust are painted over. In those cases major portions of the rust are blasted off and the surface made smooth and uniform.

Dirt and Dust: Excess particles of dirt and dust on surfaces to be painted prevent the application of a uniform coat of paint. Loose dirt particles should be brushed, vacuumed, or washed off the surface prior to coating to assure adherence of the paint.

Salts: Salts accelerate corrosion. If paint is applied over salts, corrosion cells develop and rust forms rapidly. Salts can become trapped in surface pits and crevasses. Therefore, when there is a risk that salts are present, particular attention must be given to cleaning these areas.

Oil and Grease: Oil or grease on a surface will prevent good paint adhesion; therefore it must be removed completely from the surface. Smoke from welding and inspection/construction markings on the steel must also be cleaned from the surface prior to paint application.

Standards for Surface Preparation: Standards for surface preparation, which determine the level to which the surface needs to be cleaned, have been developed by many organizations and in several countries. The specific standards for surface preparation are stated in a ship repair contract. Standards of importance to U.S. shipbuilding are:

- Steel Structures Painting Council: SP-1 Solvent Cleaning, SP-2 Hand Tool Cleaning, SP-3 Power Tool Cleaning, SP-5 White Metal Blast Cleaning, SP-6 Commercial Blast Cleaning, SP-7 Brush Off Blast Cleaning, SP-10 Near White Metal Cleaning, and SP-11 Power Tool Cleaning to Bare Metal.
- National Association of Corrosion Engineers: NACE Standards – Grade 1 "White Metal Surface," Grade 2 "Near White Metal Surface," Grade 3 "Commercial Finish," Grade 4 "Brush Off Blasting."
- Various U.S. Government Specifications also exist for ship repair. For example, Fed-Spec TT-490, "Cleaning Methods and Pretreatment of Ferrous Surfaces of Organic Coatings" and Department of the Navy, Naval Sea Systems Command: Chapter 631, "Preservation of Ships in Service."

Surface Preparation Techniques:

Solvent, Detergent, and Steam Cleaning Surface Preparation: Respondent frequently removed grease, oil and other contaminants for surface preparation with the aid of solvents, emulsions, detergents, and other cleaning compounds. Solvent cleaning involves wiping, scrubbing, immersing in solvent, spraying, vapor decreasing, and emulsion cleaning the surface with rags or brushes until the surface is cleaned. The final wipe down must be performed with a clean rag, brush, and solvent. Inorganic compounds such as chlorides, sulfates, weld flux, rust and mill scale cannot be removed with organic solvents. In many cases steam cleaning is a better alternative to solvent wipe down. Steam cleaning or high pressure washing is used to remove dirt and grime that is present on top of existing paint and bare steel.

Abrasive Blasting: Abrasive blasting (also referred to as "sand-blasting" – although Respondent never used sand as an abrasive) was the most common method for paint removal and surface preparation by Respondent. Copper slag grit was the most frequently utilized abrasive by Respondent.

Dry Abrasive/Air Nozzle Blasting: Dry abrasive blasting is also referred to as air nozzle blasting. Air nozzle blasting is probably the most common type of blasting found in the shipbuilding and repair industry. Dry abrasive blasting is used for nearly all interior tank preparation and exterior hull preparation. Dry abrasive blasting is a process by which the blasting abrasive is conveyed in a medium of high pressure air (approximately 100 pounds per square inch) through a nozzle at velocities approaching 450 feet per second. The grit impinges the surface, causing abrasion. Air nozzle blasting is generally accomplished manually by shipyard blasters. Dry abrasive blasting can be performed either within a building or in the open air, depending on the application. Open air blasting by Respondent was performed primarily in the dry-docks at the Shipyard, when the ship's hull was exposed. Interior spaces of a ship, such as tanks, were blasted either in the dry-dock or at berth.

Procedure Generally Used for Dry Abrasive Blasting: The following is a general description of the procedures used when Respondent performed dry abrasive blasting:

1. Grit blast material was delivered to the Shipyard or NWM by rail car, dump truck, barge, large vacuum truck, or some other transportation method.
2. The grit was then placed in a storage area.
3. Shipyard containers were used to transport grit to yard locations where blasting occurred.
4. Abrasive was transferred into the portable or permanent blasting machine pressure pots.
5. Shrouding (if required) was put in place to minimize the amount of fugitive abrasive during open air blasting.
6. Blasting commenced when the grit was loaded in the pressure pot and air pressure was at operating range.
7. Large amounts of dust were developed during blasting and spent abrasive, old paint particles, fouling organisms, and other debris fell to the underlying surface, such as the floor of the dry dock. Dust collectors and ventilation systems were used in enclosed areas.
8. The debris produced by the blasting operation normally was cleaned up with the aid of scoop tractors, vacuum truck and machines, and/or hand brooms and shovels. Cleaning the dry-docks was the responsibility of the Port, regardless of which contractor performed the blasting, and the Port was responsible for obtaining and complying with all environmental permits for discharges resulting from blasting operations.
9. Spent grit was often stored on-site in piles until such time as transportation could be arranged.
10. The used grit material and associated waste was then disposed of appropriately.

Types of Abrasive: Copper slag is produced during the recovery and processing of nonferrous metal from natural copper ores. The slags are molten by-products of high temperature processes that separate the metal and nonmetal constituents contained in the bulk ore. When cooled, the molten slag converts to a rocklike or granular material. This waste material is then processed into an abrasive that can be used for surface preparation. The term "copper slag" relates to the type of ore from which the slag is derived. The virgin abrasive contains only a minute amount of copper, typically less than 1,500 parts per million (ppm) total copper and 1 ppm soluble copper.

<u>Hand Tool Surface Preparation</u>: Respondent also commonly used hand tools such as grinders, wire brushes, sanders, chipping hammers, needle guns, rotary peening tools, and other impact tools for surface preparation. These hand tools were ideal for small jobs, hard to reach areas, and areas where blasting grit would be too difficult to contain.

<u>Chemical Surface Preparation</u>: Chemical surface preparation consists of alkaline paint removers and cleaning solutions, chlorinated solvents, and pickling. These alkaline cleaning solutions came in a variety of forms and were used in a variety of manners. Alkaline cleaners can be brushed on, sprayed on, and applied in a dip tank. Respondent used chemical surface preparation for small parts and performed this process primarily within NWM shops and occasionally onboard ships.

Pickling for Surface Preparation: Pickling is a process of chemical abrasion/etching, which prepares surfaces for good paint adhesion. The pickling process is used mainly for preparing pipe systems and small parts for paint. The pickling process was performed by a subcontractor outside of the Shipyard area, after which the parts were returned to Respondent for installation aboard ship.

Painting: Painting was performed at many locations throughout the Shipyard, due to the wide variety of work performed at the shipyard. In addition, Respondent painted smaller parts in the NWM paint shop. The nature of shipbuilding and repair requires several types of paints to be used for a wide variety of applications. Paint types ranged from water-based coatings to high performance epoxy coatings. The type of paint needed for a certain application depended upon the environment to which the coating would be exposed. Paint applications equipment ranged from simple brush and rollers to airless sprayers and automatic machines. Unless a part or section of a ship could be removed and painted within a shop, Respondent performed the coating application process on the ship, either at berth or dry-dock. Respondent commonly performed marine coating application on these areas of a ship:

- Underwater Hull
- Freeboard
- Topside Superstructures and Deck Houses
- Internal Spaces and Tanks
- Weather Decks
- Loose Equipment

Many different painting systems existed for each of these locations. In almost all cases, the customer would specify the type of coating system to be applied to the ship; thus Respondent was required by contract to apply a specific coating. In the large majority of instances, the customer would purchase and provided the coatings to Respondent, under a separate purchase agreement between the customer and a paint manufacturer (known as Customer Furnished Materials or Government Furnished Materials). Consequently, Respondent rarely was involved in the selection or purchasing of coatings.

The Shipyard had specific buildings and yard locations where painting occurred, and at which Respondent performed coating application, pursuant to written agreements with the Port, which to the extent they are in Respondent's possession or under Respondent's control are included in the electronic document database submitted herewith. The principal blast and coat facility at the Shipyard was located in Building 73, which contained the main paint booth and two blast booths. The paint booth was 158 feet (48.1 meters) long x 50 feet (15.2 meters) wide x 35 feet (10.6 meters) tall, giving 7,900 square feet (733 square meters) of spray area.

Shipyard Paint Coating Systems: Paints are used for a variety of purposes on many different locations on ships. No one paint can perform all of the desired functions (*e.g.*, rust prevention, fouling prevention, and alkaline resistance). Paints are made up of three main ingredients: pigment, a vehicle, and a solvent. Pigments are small particles that determine the color as well as the many ascetic or performance properties associated with the coating. The vehicle can be thought of as the glue that holds the paint pigments together. Many paints are referred to by their binder type (*e.g.*, epoxy, alkyd, urethane, vinyl, or phenolic). The binder is also very important for determining the coating's performance characteristics (*e.g.*, flexibility, chemical resistance, durability, and finish). The solvent is added to thin the paint and allow for flowing application to surfaces. The solvent portion of the paint evaporates when the paint dries. Solvents include both organic solvents and water.

Anticorrosive and antifouling paints typically are used on ships' hulls and are the two main types of paint used in the shipbuilding and repair industry. Anticorrosive paints are either vinyl- or epoxy-based, and usually contain inorganic zinc as the primary anticorrosive compound. Coal tar epoxy coatings were used for many years on ships, typically in fuel or cargo tanks. However, the application of coal tax epoxy coatings was phased out for occupational health and safety reasons in the United States in the 1970s.

Antifouling paints are designed to prevent attachment and growth of marine organisms on the underside of ships. To achieve different colors, lampblack, red iron oxide, or titanium dioxide may be added to the paint. Copper-based (in the form of cuprous oxide) paints were the most commonly used antifouling paints during Respondent's Active Operations Period. Tributyl tin (TBT) was also used as an antifoulant in underwater hull coatings for a period beginning around 1970 and ending around 1990. However, to the best of Respondent's information, knowledge and belief after due inquiry, Respondent did not apply TBT coatings to ships.

Shipyard Primer Coatings: The first coating system applied to raw steel sheets and parts is generally preconstruction primer. This preconstruction primer is sometimes referred to as shop primer. This coat of primer is important for maintaining the condition of the part throughout the construction process. Preconstruction priming is performed on steel plates, shapes, sections of piping, and ventilation ducting. This shop primer has two important functions: (1) preserving the steel material for the final product; and (2) aiding in the productivity of construction. Most preconstruction primers are zinc-rich with organic or inorganic binders. Zinc silicates are predominant among the inorganic zinc primers. Zinc coating systems protect steel surfaces in much the same manner as galvanizing. If zinc is coated on steel, oxygen will react with the zinc to form zinc oxide, which forms a tight layer that does not allow water and air to come into contact with the steel. Until the late 1980s, zinc chromate compounds were the most common chemical form of zinc in most primers. These coatings were removed from use for occupational health and safety reasons and generally were replaced with organic zinc compounds.

Paint Applications Equipment: There are many types of paint application equipment used in the shipbuilding and repair industry. Two main methods used are compressed air and airless sprayers. Compressed air sprayers were common in the past but are now nearly phased out in the industry because of the low transfer efficiency of the system. Air assisted paint systems spray both air and paint which causes some paint to atomize (dry) quickly prior to reaching the intended surface. The transfer efficiency of air assisted spray systems can vary from 65% to 80%. The most widely used type of paint application currently in the shipbuilding and repair industry is the airless sprayer. Respondent exclusively used airless sprayers during Respondent's Active Operations Period. Airless sprayers use hydrostatic pressure instead of air to convey the paint. Airless sprayers are much cleaner to operate and have fewer leaking problems because the system requires less pressure. Airless sprayers can have close to 90% transfer efficiency depending on the specific conditions.

Painting Practices and Methods: Painting was performed in many areas of the Shipyard and NWM from the initial priming of the steel to the final paint detailing of the ship. Methods for painting varied greatly from process to process. Mixing of paint was performed both manually and mechanically and was done in areas (some of which were covered) contained by berms, tarps, and/or secondary containment pallets.

Surface Preparation and Painting Areas at the Shipyard: The following five areas are described to illustrate how painting occurred at the Shipyard and NWM:

Hull Painting: Hull surface preparation and painting on repair ships normally was performed when the ship was fully dry-docked. Compressed air dry abrasive blasting with copper slag grit was the most common type of surface preparation for hulls. Surface preparation involved blasting the hull surface from platforms or lifts. Paint was sprayed onto the hull using airless sprayers and high-reach equipment such as lifts or scaffolding. As noted above, cleaning the dry-docks and properly disposing of the resulting waste were the Port's responsibilities.

Superstructure Painting: The superstructure of the ship consists of the exposed decks, deck houses, and structures above the main deck. In many cases, scaffolding would be used onboard the ship to reach antennas, houses, and other superstructures. For repairs, the ship's superstructure usually was painted while the ship was berthed. The surface was prepared using either hand tools or air nozzle blasting. As noted above, Respondent exclusively used airless paint sprayers during Respondent's Active Operations Period, which minimized fugitive emissions. The painters accessed the superstructures with existing scaffolding, ladders, and various lifting equipment that were used during surface preparation.

Interior Tank and Compartment Painting: Tanks and compartments onboard ships must be recoated periodically to maintain the longevity of the ship. Recoating of ship tanks requires a large amount of surface preparation prior to painting. The majority of the tanks are at the bottom of the ship (*e.g.*, ballast, bilge, and fuel tanks). The tanks are prepared for paint by using solvents and detergents to remove grease and oil buildup. The associated wastewater generated during tank cleaning must be properly treated and disposed. At the Shipyard, this wastewater was transferred to an onsite water treatment facility operated by the Port, and as with other processes discussed herein the Port was responsible for proper treatment and disposal. After the tanks were dried, they were blasted with a mineral slag. During the blasting operation, the tank had recirculating air, and the grit was vacuumed out. The vacuum and ventilation systems generally were located on the dock's surface, and these systems accessed the tanks through holes in the hull. Once the tank surface was blasted and the grit was removed, painting began.

Small Parts Painting Areas: Many parts of a ship need to have a coating system applied to them prior to installation. For example, piping spools, vent ducting, foundations, and doors were painted before they were installed. Small parts generally were prepared for paint in a designated area of the Shipyard or NWM. The parts were prepared for paint by air blasting or by one of the other techniques discussed above. Some small parts painting occurred in various areas of the Shipyard, while other parts were painted in the NWM paint shop.

Surface Preparation and Painting On-Block and Onboard: Final painting of the ship occurred onboard, and touch-up painting frequently occurred on-block. On-block touch-up painting occurred for several reasons. In some cases, paint systems were damaged on-block and needed to be resurfaced, or the wrong paint system was applied and needed to be replaced. On-block painting involved using portable blasting and painting equipment throughout the on-block outfitting areas. Onboard painting involved preparing and painting the interface sections in between the construction blocks and repainting areas damaged by welding, rework, onboard outfitting, and other processes. Respondent prepared the surfaces with hand tools, sanding, brushing, solvent cleaning, or any of the other surface preparation techniques. Respondent applied paint with portable airless sprayers, rollers, and brushes.

Paint Storage, Transportation, and Collection for Disposal: Paint was stored many places at the Shipyard, depending on the length of storage and the volume of paint stored. Respondent also stored smaller quantities of paint at the NWM paint shop. The Shipyard's main storage area was used for larger quantities and longer storage, sometimes for months. When paint was needed throughout the Shipyard, it was transferred to satellite storage and work areas. Finally, paint was transported by individual cans or pallets from the satellite storage areas to individual work sites where paint was mixed and sprayed.

Once the painters finished their individual paint job, they would discard any unused paint and clean their equipment. The majority of paints that Respondent used had to be either used or disposed of once they were mixed. In general, painters would discard their paint and paint associated waste (*e.g.*, rags, rollers, gloves, and thinner) into 55-gallon drums in satellite collection areas around the Shipyard. Materials from these satellite collection areas would then be transferred to receptacles for the three main waste streams: paint waste, thinner, and solids (*e.g.*, rags, gloves, and paint brushes).

Spray guns and hoses were cleaned with solvents to prevent being clogged with dried solvents. This cleaning process was accomplished by filling the paint pots with solvents and "spraying" the solvent through the guns into a drum. This solvent would be reused several times until it was "spent," at which point it was ready for recycling or disposal as described in Part 5 of this report.

Part 5

Respondent's Waste Management Practices

Introduction to waste generation, management and disposal: Respondent's activities, both onboard ships and at NWM facilities, generated waste, both nonhazardous (solid) and hazardous. Most of these wastes were generated in the Shipyard from work onboard ships. Additionally, a ship's crew, while in the Shipyard, frequently disposed of waste generated from the ship's operations independently of any wastes that Respondent generated.

As discussed above, Respondent did not own ship docking (dry-dock, pier or berthing) facilities. Instead, the Port owned and operated the dry-docks, piers and berths where the vast majority of Respondent's ship repair work occurred and where most of the waste was generated. The Port was responsible for management and disposal of the waste generated in these areas, which resulted in the Port managing and disposing of the vast majority (likely greater than 90%) of all wastes streams generated from Respondent's work.

Ship Waste Management: The largest volume waste streams Respondent generated were produced from a few specific processes conducted onboard ships at the Shipyard. These processes included hull cleaning, surface preparation, tank cleaning, bilge cleaning and ship painting. Specific details on waste management practices for these processes are provided below.

Hull Cleaning: Hull cleaning is the process by which a ship's hull was prepared for surface preparation and painting. The process typically started with pressure washing with fresh water to remove attached marine organisms, "slime" and soluble salts. In some instances scraping with long-handled blades was necessary to remove barnacles and other strongly adhering organisms. Respondent performed this work in the dry-dock, and the marine foulants fell to the dry-dock floor. After the hull cleaning was completed, the dry-dock floor was swept clean, and the dead organisms were picked up and placed in bins for disposal as nonhazardous waste.

Surface Preparation: If the hull was to be painted, its surface was cleaned using dry abrasive blasting (see Part 4: Surface Preparation and Coating). The grit (copper slag) that Respondent used for blasting would fall to, and accumulated on, the dry-dock floor. Depending upon many factors, a range of approximately 50 to 500 tons of grit might be used on a single job. As noted above, the Port was responsible for managing and disposing of this spent grit. Any other solid wastes Respondent generated during surface preparation operations would be placed in bins and removed from the dry-dock for disposal by Respondent.

Tank Cleaning: Tanks on board ships are interior spaces utilized for holding both dry and liquid cargos and other fluids required for ship operations. Cargos include dry and fluid chemicals, foods stuffs, various petroleum products such as crude oil and petroleum distillates, and many other substances. Fluids required to operate the ship include bunker fuels, potable water and ballast water. Cleaning these tanks is necessary for several reasons, including corrosion control, prevention of cargo contamination, and repair of the interior tank spaces.

Tank cleaning was accomplished both by automatic cleaning equipment (Butterworth machines) and manually by workers inside the tanks. Tank surfaces were cleaned using steam, hot pressured water, water and detergents, and/or other solvents. The residual fluids were vacuumed from the tanks and either stored in fixed or mobile onshore holding tanks or pumped directly into a vacuum truck for transport. If fuels or other reusable fluids were removed from a ship's tank, they were held in a barge or onshore tank until ship repairs were completed; at that time these fluids were returned to the ship. Ballast waters, unless contaminated, typically would be discharged by the ship's operator to surface waters prior to a ship being dry-docked.

The largest waste stream derived from tank cleaning was oily water. At the Shipyard, Respondent transferred all tank cleaning residuals from a ship to the Shipyard's ballast water treatment facility. See NWMAR106631, provided herewith in hard copy. The Port exclusively managed treatment and disposal of these wastes. Respondent believes the primary treatment method employed by the Port was density separation (settling) for the oil and water, then decanting the treated water to tanks. Respondent further believes the Port sent waste oil offsite for recycling or disposal and discharged the treated water to either the Willamette River or the onsite industrial waste water sewer system.

<u>Bilge Cleaning/Maintenance</u>: Bilge cleaning is similar to tank cleaning in that fluid accumulations (typically oily water) in the ship's bilges are removed to accommodate machinery repair. Bilges were cleaned using steam, hot pressured water, water and detergents, and/or solvents. The residual fluids were vacuumed from the bilges and either stored in fixed or mobile onshore holding tanks or pumped directly into a vacuum truck for transport.

The primary waste stream derived from bilge cleaning was oily water. At the Shipyard, Respondent transferred all bilge cleaning residuals from a ship to the Shipyard's ballast water treatment facility. The Port exclusively managed treatment and disposal of these wastes, as described above with respect to tank cleaning.

<u>Ship Painting</u>: Ship painting generated considerable amounts of solid wastes, such as paint-contaminated debris, painting disposables and empty paint cans, and lesser amounts of liquid wastes, such as unused paint and spent solvents. The painters placed solid paint wastes in bins on the dry-dock. When the solid waste receptacles were full, Respondent transported them to the NWM facility for characterization and management. Nonhazardous solid wastes from Respondent's ship painting activities in the Shipyard were disposed together with nonhazardous solid waste from the NWM facility. Waste characterized as hazardous was transported to Respondent's hazardous waste storage area, and Respondent arranged for proper offsite disposal.

Respondent also removed any liquid wastes generated on the dry-dock to its waste management area for waste classification, consolidation, and disposal. Respondent disposed of liquid wastes by sending them to a solvent reclamation facility or by disposing of them as hazardous waste, as appropriate. In addition, Respondent was responsible for collection and disposal of all liquid and solid paint-related waste generated by the NWM paint shop, but this waste stream was much smaller than the waste stream resulting from Respondent's painting operations at the Shipyard.

Asbestos Remediation: Asbestos was commonly used on ships as both insulation and as a fire barrier. Removal of asbestos was commonly accomplished by Respondent using subcontractors and the NWM carpentry shop. Asbestos remediation projects were managed as both an occupational health hazard and an environmental pollutant.

Polychlorinated Biphenyls: In the past, liquid polychlorinated biphenyls (PCBs) were common in dielectric fluids for transformer cooling. In addition, many Navy and commercial ships built prior to 1970 contained solid PCBs in various components, such as plastics, rubbers, adhesives, gaskets, power cable insulation and other commercial nonmetal products. See NWMAR055388. The U.S. Maritime Administration has performed extensive sampling of its inactive reserve fleet, in anticipation of disposal of these ships, and has identified an occasional ship that contained PCBs in the exterior hull coatings. The Maritime Administration has been unable to determine the source of PCBs in these marine coats and believes that the contamination may have occurred outside the U.S. when a ship was repainted overseas, using locally available coatings.[2] Reference materials discussing PCBs on marine vessels are included in Appendix 3: PCB on Vessels References.

Facility Waste Management: Facility waste management consisted of Respondent collecting and disposing of both nonhazardous (solid) and hazardous waste generated by Respondent within NWM facilities. The majority of these wastes were nonhazardous. During Respondent's Active Operations Period, there was no treatment or disposal of waste onsite at NWM.

The NWM facility waste streams consisted of:

- Oil and oily water
- Scrap wood, plastic, paper, cardboard, etc.
- Scrap metal
- Waste oil, lubricants, cutting fluids
- Sanitary waste
- Empty paint containers
- Shop rags and other shop disposables
- Waste paint
- Spent solvents
- Coolants
- Misc. cleaning chemicals
- Misc. shop chemicals
- Aerosol cans

The small quantities of hazardous wastes generated were accumulated within marked satellite accumulation areas near the point of generation. At appropriate intervals, similar wastes would be consolidated and stored in Respondent's hazardous waste storage areas until manifested to a licensed treatment, storage and disposal facility. Nonhazardous waste was disposed of in bins and garbage containers within NWM facilities, and a contracted waste hauler regularly picked up the waste and transported it to a local land fill.

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[2] Personal Communication from William Barnes, Maritime Administration, to Dana Austin, on August 12, 2008.

Glossary of Terms

Accommodation. All spaces on a ship that are associated with the crew's normal living, including navigation, radio, and similar spaces when incorporated in the same deckhouse.

Aft. Toward, at, or near the stern.

Amidships. A point which is exactly halfway between the fore and after perpendiculars.

Anchor. A device, usually of steel, used to hold a ship against the movement of current, tide, and wind.

Assemble. To fit and join parts together.

Assembly. See Subassembly.

Auxiliary Machinery. Various pumps, motors, generators, and other equipment required on a ship, as distinguished from main propulsive machinery units.

Ballast Tank. Watertight compartment to hold ballast water.

Berth. Where a ship is docked or tied up; a place to sleep aboard ship; a bunk or bed.

Bilge. Curved section between the bottom and the side of the vessel; also the lowest part of a vessel's internal spaces into which water drains.

Bilge and Ballast System. A piping system generally located in holds or lower compartments of a ship and connected to pumps. This system is for pumping overboard accumulations of water in holds and compartments and also for filling and emptying ballast tanks.

Bilge Blocks. Blocks set under the bilge for support during construction or during docking.

Bilge Plates. The curved shell plates that form the bilge.

Block. A three-dimensional section of a ship structure. Blocks are combined to form a ship during erection, and are normally the largest sections to be assembled away from the erection site.

Blue Sky. In the open; not under a roof or other protection from the weather.

Blue Sky Outfitting. Outfitting done in the open during hull erection, *e.g.*, landing outfit units or components before a space is enclosed.

Boody Hatch. An access hatch from a weather deck protected by a hood from sea and weather; also called companionway.

Boom. A round spar hinged at its lower end, usually to a mast or a crane, and supported by a wire rope or tackle from aloft to the upper end of the boom. Cargo, stores, etc., are lifted by tackle leading from the upper end of the boom.

Bow. Forward end of a ship.

Bracket. A structural member used to rigidly reinforce two or more structural parts, which are joined at approximately right angles to each other, such as deck beam to frame, or bulkhead stiffener to the deck or tank top; usually a plate.

Bridge, Flying. The platform forming the top of the pilothouse.

Bridge House. A part of the upper superstructure of a ship. The officers' quarters, staterooms, and accommodations are usually located in the bridge house and the pilothouse located above it.

Building Basin. A structure essentially similar to a graving dock, in which one or more ships or parts of ships may be built at one time; no launching operation is required, as the ship is floated by flooding the basin.

Bulbous Bow. A bow with a rounded, protruding shape at the bottom to improve flow and resistance characteristics.

Bulk Carrier. Ships designed to carry bulk cargo, usually not in liquid form, such as coal, ore, grain, etc.

Bulkhead. A vertical partition, which subdivides the interior of a ship into compartments or rooms. Bulkheads which contribute to the strength of a vessel are called strength bulkheads; those which are essential to the watertight subdivision are watertight or oiltight bulkheads. Gastight bulkheads serve to prevent the passage of gas or fumes.

Butt. The joint formed when two parts are placed edge to edge; the end joint between two plates; also transverse joints for connecting two parts, subassemblies, or blocks.

CNC. Computer Numeric Control.

CAD. Computer Aided Design.

CAM. Computer Aided Manufacturing.

Come Along. A hand-operated lever hoist used during shipfitting for pulling together or supporting ship's parts or subassemblies.

Compartment. A subdivision of space or room in a ship.

Compartmentation. The subdividing of the hull by watertight bulkheads so that the ship may remain afloat under certain conditions of flooding.

Crane. A device for lifting and moving heavy weights by means of a movable projecting arm and/or a horizontal beam.

Deck. A horizontal surface in a ship corresponding to a floor in a building. It is the plating, planking, or covering of any tier of beams in either the hull or the superstructure of a ship. Decks are usually designated by their location, as boat deck, bridge deck, upper deck, main deck, etc. Decks at different levels serve various functions; they may be either watertight decks, strength decks, or simply cargo and passenger accommodation decks.

Deckhouse. A comparatively light structure, built on the hull, which does not normally extend from side to side of the ship. It commonly is composed of spaces that are used for crew accommodations and control of the ship (bridge, radioroom, etc.)

Deck Machinery. Miscellaneous machinery located on the decks of a ship such as windlasses, winches, etc.

Double Bottom. Compartment at the bottom of a ship between inner bottom and the shell plating, mostly used for ballast water, fresh water, or fuel oil.

Draft. The depth of the ship below the waterline measured vertically to the lowest part of the hull, propellers, or other reference point. When measured to the lowest projecting portion of the vessel, it is called the **extreme draft**, when measured at the bow, it is called **forward draft**, and when measured at the stern, the **after draft.** The average of the forward draft and the after draft is the **mean draft**, and the mean draft when in full load condition is the **load draft.** Also, in cargo handling, the unit of cargo being hoisted on or off the ship by the cargo gear at one particular hoist.

Engine Room. The location of main propulsion and some auxiliary machinery onboard a ship.

Erection. The placing and connection on the ways or other building position of subassemblies, blocks, and/or outfit units of a ship.

Fabricate. To process materials in the shops, to create parts needed for both hull and outfit assemblies. In hull work, fabrication consists of cutting (shearing), shaping, punching, drilling, countersinking, scarfing, rabbeting, beveling, and welding.

Flange. The part of a plate or shape bent at right angles to the main part; to bend over to form an angle.

Fore. A term used in indicating portions or that part of a ship at or adjacent to the bow.

Fore and Aft. In line with the length of the ship; longitudinal.

Forward. In the direction of the bow.

Foundation. A structural support for equipment and machinery installed on a ship. The structural supports for the boilers, main engines or turbines, and reduction gears are called the **main foundations**. Supports for auxiliary machinery are called **auxiliary foundations.**

Frame. A term used to designate one of the transverse members that make up the riblike part of the skeleton of a ship. The frames act as stiffeners, holding the outside plating in shape and maintaining the transverse form of the ship.

Freeing Port. An opening in the lower portion of the bulwark which allows water on deck to drain overboard.

Galley. A cook room or kitchen on a ship.

Gangway. A passageway, side shell opening, and ladder way used for boarding a ship.

Gantry Crane. A hoisting device, usually travelling on rails, having the lifting hook suspended from a car which is movable horizontally in a direction transverse to the rails.

Graving Dock. A structure for taking a ship out of water, consisting of an excavation in the shoreline to a depth at least equal to the draft of ships to be handed, closed at the water side end by a movable gate, and provided with large capacity pumps for removing water; blocks support the ship when the dock is pumped out.

Hatchway. An opening in a deck through which cargo and stores are loaded or unloaded.

Hold. The large space below deck for the stowage of cargo; the lowermost cargo compartment.

Hull. The structural body of a ship, including shell plating, framing, decks, bulkheads, etc.; also the outfit specialty design group dealing with all areas of the ship except machinery and superstructure.

Hull Block Construction Method. A shipbuilding system wherein hull parts, subassemblies, and blocks are manufactured in accordance with the principles of group technology.

Jig. A device, often with metal surfaces, used as a tool or template.

Keel. The principal fore-and-aft component of a ship's framing, located along the centerline at the bottom and connected to the stem and stern frames. Floors or bottom transverses are attached to the keel.

Keel Blocks. Heavy wood or concrete blocks on which a ship rests during construction or dry-docking.

Labor Turnover. The number of separations divided by average employment during a specified time interval multiplied by 100 (the number of separations during the period per 100 employees). Annual turnover rate is the monthly turnover multiplied by 12.

Launching. To set a ship afloat for the first time.

Layout. The process of making a plate assembly showing the location of longitudinals, frames, edges, and attached parts.

Loftwork. The laying off of full form details at full size in preparation for cutting plate and structural members. The process is now almost entirely computerized.

Longitudinal. A fore-and-aft structural shape or plate member attached to the underside of decks or flats, or to the inner bottom, or on the inboard side of the shell plating.

Machinery. All spaces on a ship that primarily contain operating equipment such as main propulsion machinery, auxiliary machinery, pumping systems, heating, ventilation, and air conditioning machinery, etc.; also the outfit specialty design group dealing with machinery spaces.

Manning. The number of workers or equivalent workers assigned to a particular ship (**ship manning**), program (**program manning**), or shipyard (**yard manning**).

Material Control. The functions of purchasing, expediting, warehousing, palletizing, and delivering material to the work site.

Mooring. Securing a ship at a dock or elsewhere by several lines or cables so as to limit its movement.

Oil Tanker. A vessel specifically designed to carry oil cargo in bulk.

Outfit. All the parts of a ship that are not structural in nature, including items such as pipes, derricks, masts, rigging, engines, machinery, electrical cable, hotel services, etc.

Pallet. A portable platform upon which materials are stacked for storage or transportation; also in zone outfitting a definite increment of work with allocated resources (information, labor, and materials) needed to produce a defined interim product.

Panel. A section of a ship consisting of one or more plates with associated strengthening members; also called a subassembly or block.

Panel Line. A production line where individual plates, framing members, webs, etc. are successively welded together to form an assembly unit which may include some outfit items.

Parts. Refers to all the steel components that are welded to a plate assembly, including stiffeners, longitudinals, frames, girders, web frames, headers, etc.

Pin Jig. A jig consisting of a grid of adjustable pins (screw jacks) used as a building position for curved blocks or a template for curved plates.

Planning. The listing of all jobs that must be performed in order to complete a project.

Platen. A flat, level structure upon which subassemblies, blocks, and/or outfit units are built.

Porthole. A hinged glass window, generally circular, in the ship's side or deckhouse, for light and ventilation; also called portlight, air port, or side scuttle.

Process Lane. A work center specifically designed to efficiently perform a certain type of work or a certain series of work steps.

Production Control. The monitoring of the difference between actual and scheduled performance of a project.

Propeller. A revolving screw-like device that drives the ship through the water, consisting of two or more blades; sometimes called a screw or wheel.

Quenching. In steelmaking, an operation consisting of heating the material to a certain temperature and holding at that temperature to obtain desired crystalline structure, and then rapidly cooling it in a suitable medium, such as water or oil. Quenching is often followed by tempering.

Rigging. Wire ropes, fiber line, tackle, etc., used to support masts, spars, booms, etc., and for handling and placing cargo onboard ship.

Rudder. A device used to steer a ship. The most common type consists of a vertical metal area, hinged at the forward edge to the stern post or rudder post.

Scaffolding. See Staging.

Scheduling. The laying out of the actual time order in which jobs are to be performed in order to complete a project.

Sea Chest. An opening for supplying seawater to condensers, pumps, etc., and for discharging water from the ship's water systems to the sea. It is a cast or built-up structure located in the hull below the waterline, having means for the attachment of the associated piping. A suction sea chest is fitted with strainers or gratings, and sometimes has a lip that forces water into the sea chest when the ship is underway.

Seam. A fore-and-aft joint of shell plating, deck and tank top plating, or a lengthwise edge joint of any plating.

Seam Line. Symbol for a welded butt joint; also called erection butt.

Seam Strap. A strap of plate serving as a connecting strap between the butted edges of plating. Strap connections at the ends of plates are called butt straps.

Shape. A rolled bar of constant cross section such as an angle, bulb angle, channel, etc.; also to impart curvature to a plate or other member.

Shell. The outer skin plates of a ship, including bottom shell and side shell.

Shell Plating. The plates forming the outer side and bottom skin of the hull.

Stage. A classification of work based on when it will be performed (in what sequence) during the construction process relative to other work.

Staging. Temporary or movable wooden or metal structures for supporting worker tools and materials; also called scaffolding.

Stern. Aft end of a ship.

Stiffener. A structural section (usually angles, tees, or I-beam) attached to a plate to strengthen it.

Subassembly. An assembly of parts (primarily structural parts). Subassemblies, when joined together, form blocks.

Superstructure. A decked-over structure above the upper deck, the outboard sides of which are formed by the shell plating, as distinguished from a deckhouse that does not extend outboard to the ship's sides.

Surface Preparation. The work required to permit coating materials (primarily paint) to be satisfactorily applied to metals.

Tank, Wing. Tanks located well outboard adjacent to the side shell plating, often consisting of a continuation of the double bottom up the sides to a deck or flat.

Waterway. A narrow gutter along the edge of the deck for drainage.

Web. The main part of a bent or flanged plate or structural section.

Work Package. A resource subdivision which specifics the material and/or labor required to complete some portion of a shipbuilding or repair contract. A work package should correspond to the work breakdown structure in use and may be either system or product oriented.

Appendix 1: NWM Process Flow Charts

1) Pipe Shop
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
2) Machine Shop
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
3) Sheet Metal Shop
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
4) Electronics Shop
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
5) Plate Shop
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
6) Materials Inventory and Distribution
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
7) Transportation
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
8) Surface Preparation
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
9) Coating Application in the Dry-dock
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
10) Tank Cleaning Onboard Ship
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
11) Bilge Maintenance Onboard Ship
   a) Process Overview
   b) Process Inputs
   c) Process Outputs
12) Waste Management
   a) Process Overview
   b) Process Inputs
   c) Process Outputs

Note: Respondent is referred to as "NWM" in these process flow charts.

See electronic files for content of Appendix 1.

Appendix 2: Material Safety Data Sheets

1. Degreaser and Engine Cleaner
2. Moly-Lith
3. Interclene Red Antifouling
4. Cool Tool II
5. Diesel Fuel (Red Dyed)
6. EP Hydraulic Oil 68
7. Gasoline, All Grades
8. Formula 151 Topcoat Epoxy
9. Epoxy Tie Coat
10. Epoxy Anticorrosive (Intertuf 262)
11. Citgo Premium Gear Oil – SAE 80W-90
12. Kleen Blast Abrasives
13. CTC All Purpose EP Grease 28-0801-0
14. Havoline Motor Oil
15. Citgo Transgard Heavy Duty Transmission Fluid – SAE 50

See electronic files for
content of Appendix 2.

Appendix 3: PCB on Vessels References

1. A Guide for Ship Scrappers: Tips for Regulatory Compliance: Chapter 3 Sampling, Removal and Disposal of Polychlorinated Biphenyls

2. National Guidance: Best Management Practices for Preparing Vessels Intended to Create Artificial Reef

3. Polychlorinated Biphenyls in Vessels

See electronic files for
content of Appendix 3.